Segment No: 18-37-02

WASHINGTON STATE DEPARTMENT OF ECOLOGY
ENVIRONMENTAL INVESTIGATIONS AND LABORATORY SERVICES

October 17, 1989

TO: Harold Porath

FROM: Marc Heffner MH

SUBJECT: Selah Wastewater Treatment Plant Class II Inspection on October 25-26, 1988

INTRODUCTION

A Class II inspection was conducted at the Selah Wastewater Treatment Plant (STP) on October 25-26, 1988. The inspection was conducted by Carlos Ruiz and Marc Heffner of the Ecology Compliance Monitoring Section. Joe Ford, the STP operator, provided on-site assistance. A concurrent receiving water study was conducted by the Ecology Surface Water Investigations Section (Joy, in preparation). Objectives of the inspection included:

1. Assess compliance with permit conditions, notably the effluent limitations.

2. Assess the permittee's self-monitoring by reviewing laboratory, sampling, and flow measurement procedures.

3. Characterize the STP performance by determining plant loadings.

4. Characterize the pretreatment system effluent.

The Selah STP is an activated sludge type secondary system (Figure 1). Process units include two aeration basins, two secondary clarifiers, and a chlorine contact chamber. Discharge is to the Yakima River via a ditch as regulated by NPDES Permit No. WA-002103-2. Waste activated sludge is aerobically digested and then spread on land. Fruit juice processor waste is pretreated in an aerated lagoon before being discharged to the Selah STP for further treatment. The inspection took place as preparations were being made to install a fabric baffle and additional aerators in the lagoon.

PROCEDURES

Ecology composite and grab samples were collected. Ecology Isco composite samplers collected pretreatment influent and effluent samples; and STP influent and effluent samples (Figure 1). The composite samplers collected approximately 200 mLs of sample every 30 minutes for 24 hours. Selah also collected STP influent and effluent samples.

Selah Manning samplers collected flow paced composite samples over a 24 hour period. All STP influent and effluent composite samples were split for analysis by the Ecology and Selah laboratories. Sample collection, sampling times, and parameters analyzed are summarized in Table 1.

Several field tests were also conducted during the inspection. Sludge depths in the clarifiers and chlorine contact basins were measured using a "Sludge Judge" core sampler. Also, the settleability of the pretreatment effluent was checked by allowing samples to settle in a one liter graduated cylinder.

Flow data were taken from the on-site pretreatment effluent and STP effluent flow meter totalizers.

RESULTS AND DISCUSSION

STP

Data indicate the STP was operating efficiently during the inspection (Table 2). Very good BOD_5 and TSS removals were observed. Nitrogen (NH_3-N + NO_2+NO_3-N) was reduced from approximately 7.5 mg/L in the influent to approximately 1.0 mg/L in the effluent.

The plant discharge was within the NPDES permit limits (Table 3). Plant TSS loading approximated design criteria, exceeded 85 percent of design capacity, and far exceeded the revised plant capacity estimate (Jump, et al, 1989). The permittee must submit "a plan and a schedule for continuing to maintain adequate treatment capacity" to comply with permit condition S10 - Prevention of Facility Overloading.

The plant was operated with a high MLSS concentration in the aeration basins. Plant operations records show the October average was 6590 mg/L. The usual range for complete mix activated sludge systems is 2000-5000 mg/L (Ecology, 1985), although STP aerator capacity is adequate to handle a MLSS of 6000-8000 mg/L (Shepherd, 1987). The clarifier core samples found fairly thick sludge blankets with clear water depths somewhat less than preferred, but acceptable (Table 4). The thin blanket of solids found in the chlorine contact basin suggests that solids carry-over from the clarifiers was not a problem.

The Microtox bioassay results rank the effluent as moderate to high priority for further investigation of toxicity (Table 5 - EPA, 1980). Neutralization of the chlorine residual provided some reduction in toxicity. Bioassay data for other test species would be useful for consideration along with the Microtox results.

The operator reported that 70000-75000 gallons of sludge were hauled for disposal five days per week. Using the plant operations record October average of 10700 mg/L TSS in the digester sludge, roughly 6500 lbs of dry solids were hauled five days per week; or a daily average of 4600 lbs. Sludge metals concentrations were in the lower end of the range of

concentrations found at other activated sludge plants in Washington (Table 6 - Hallinan, 1988).

Digester efficiency appeared low based on calculations done with available VSS data (Table 7). Calculations indicate a 19 percent VSS reduction in the digester with a VSS concentration in the digested sludge of 74 percent. These numbers do not compare favorably with expected volatile solids reductions (Table 7; Ecology, 1985). Although "Process to Significantly Reduce Pathogens" guidelines were not met, land spreading on land not used for growing food or feed crops may be allowed at the discretion of the local health department (Ecology, 1982). VSS loading to the digester was below the acceptable range suggesting adequate capacity (Table 7). However, the hydraulic detention time was well below suggested design criteria. Thickening the waste activated sludge prior to digestion could increase the detention time and may improve digester performance.

Pretreatment Lagoon

During the inspection the pretreatment lagoon was full. Thus, detention of high daily flows for release on low flow days was not possible.

The pretreatment system reduced the BOD_5 concentration from an influent of 1500 mg/L to an effluent of 270 mg/L (Table 2). The pretreatment effluent soluble BOD_5 was <5 mg/L indicating the BOD_5 was associated with the solids. Flow and BOD_5 from the pretreatment system represented 43 percent and 58 percent of the STP loading, respectively (Table 8). The inspection data appear representative of the October Selah STP operational data.

Approximately 84 percent of the TSS load to the STP was from the pretreatment system (Table 8). The pretreatment effluent TSS loading to the STP of 5500 lbs/D exceeded both the revised estimated plant capacity of 3300 lbs/D and the STP solids wasting of 4600 lbs/D. The STP digester sludge was 74 percent volatile SS while the pretreatment effluent was approximately 84 percent VSS (effluent composite 81 percent VSS, effluent grab 84 percent VSS, October plant records 87 percent VSS). Thus, pretreatment effluent solids reduction by the Selah STP appears to have occurred.

The pretreatment system TSS load should be considered when adequate treatment capacity at the STP is addressed. Two alternatives considered should include:

1. Volatile solids reduction as part of pretreatment. The 5500 lbs/D of TSS sent to the STP was approximately 84 percent volatile. Reducing the VSS to 74 percent would reduce the TSS load to the STP to 3385 lbs/D.

2. Solids removal as part of pretreatment. Initial effluent settleability tests conducted during the inspection indicated

potential for solids removal (Table 9). Some value as animal feed may be realized from pretreatment solids removed prior to contamination with sanitary wastes at the STP.

Laboratory Review

Laboratory procedures at Selah appeared acceptable. The "Laboratory Procedure Review Sheet" included in the appendix notes areas where minor procedural modifications are suggested.

Analytical results of the split samples are summarized in Table 10. Results comparison was acceptable for most parameters. An unexplained difference in influent BOD_5 results was observed. An additional sample split is recommended at a later date. Comparability was marginal for the low concentrations of NH_3-N observed in the effluent; but the influent results, which approximated the concentration range necessary to measure permit compliance, compared closely.

CONCLUSIONS AND RECOMMENDATIONS

STP

The STP was performing well during the inspection. NPDES Permit effluent limits were being met. Influent TSS loading was within 85 percent of plant capacity creating the need for the permittee to submit a plan and a schedule for continuing to maintain adequate treatment capacity.

Pretreatment Lagoon

The pretreatment lagoon was providing good BOD_5 reduction. Approximately 84 percent of the STP TSS loading was coming from the lagoon. Improving pretreatment to reduce TSS loading to the STP should be considered in developing the STP adequate capacity plan. Volatile solids reduction or solids removal are alternatives that should be addressed.

Laboratory Review

Procedures were generally good. Minor procedural recommendations are noted in the "Laboratory Procedure Review Sheet" included in the appendix. Sample splits compared well with the exception of the influent BOD_5. An influent sample split for BOD_5 analysis is recommended during a future inspection.

REFERENCES

Ecology, 1982. Municipal and Domestic Sludge Utilization Guidelines, WDOE 82-11, October 1982.

Ecology, 1985. Criteria for Sewage Works Design, DOE 78-5, revised October 1985.

EPA, 1980. Level 1 Biological Testing Assessment and Data Formatting, EPA-600/7-80-079, April 1980.

Hallinan, P., 1988. Metals Concentrations Found During Ecology Inspections of Municipal Wastewater Treatment Plants, memo to John Bernhardt, April 11, 1988.

Joy, J. (in preparation), Selah STP Receiving Water Study.

Jump, Huibregtse Associates and Esvelt Environmental Engineering, 1989. City of Selah Industrial Wastewater Treatment Long Range Plan, January 9, 1989.

Shepherd, Preston L. and Associates, Inc., 1985. City of Selah Wastewater Treatment Plant Improvements with Industrial Pretreatment, Engineering Report, March 1985.

Shepherd, Preston L. and Associates, Inc., 1987. City of Selah Wastewater Treatment Plant Operation and Maintenance Manual, April 8, 1987.

MH:pd
Attachments

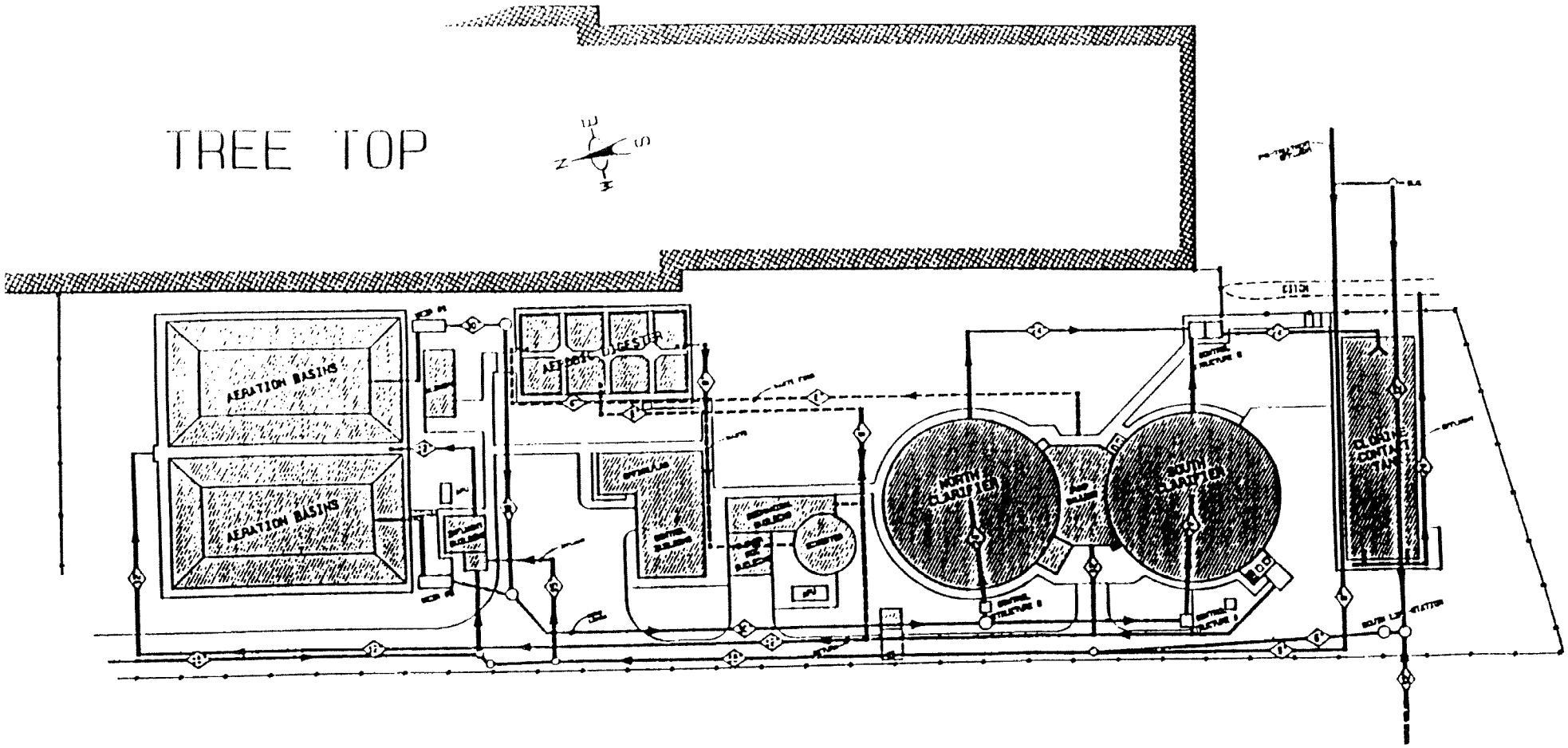

Figure 1 - Selah STP Flow Scheme - Selah, October 1988.

Table 1 - Sampling Schedule - Selah, October 1988

Station	Sampler	Date (October)	Time	Field Analyses						Laboratory Analyses																				
							Chlorine Residual						Solids						Nutrients												
				Temperature	pH	Conductivity	Free	Total	Fecal Coliform	BOD5	Soluble BOD5	COD	TS	TNVS	TSS	TNVSS	Turbidity	NH3-N	NO2-N	NO2+NO3-N	O-PO4-P	Total P	pH	Conductivity	Alkalinity	Hardness	Metals	% Solids	Microtox
Composite																														
STP Samples																														
Influent	Eco	25-26	0730-0730	X	X	X				X*		X	X	X	X*	X	X	X*	X	X	X	X	X	X	X	X			
Effluent	Eco	25-26	0700-0700	X	X	X				X*		X	X	X	X*	X	X	X*	X	X	X	X	X	X	X	X			X
Influent	Sel	25-26	0730-0730	X	X	X				X*		X	X	X	X*	X	X	X*		X		X	X	X	X				
Effluent	Sel	25-26	0730-0730	X	X	X				X*		X	X	X	X*	X	X	X*		X		X	X	X	X				
Pretreatment Samples																														
Influent	Eco	25-26	0730-0730	X	X	X				X		X	X	X	X	X	X	X	X	X		X	X	X	X				
Effluent	Eco	25-26	0720-0720	X	X	X				X	X	X	X	X	X	X	X	X	X	X		X	X	X	X				
Grab																														
STP Samples																														
Influent	Eco	25	1004	X	X	X						X			X	X	X	X		X		X	X	X	X				
		25	1332	X	X	X						X			X	X	X	X		X		X	X	X	X				
		26	0915	X	X	X						X			X	X	X	X		X		X	X	X	X				
Effluent	Eco	25	1035	X	X	X	X	X				X			X	X	X	X		X		X	X	X	X				
		25	1347	X	X	X	X	X	X			X			X	X	X	X		X		X	X	X	X				
		26	0800					*																					
		26	0930	X	X	X	X	X	X*			X			X	X	X	X		X		X	X	X	X				
Sludge	Eco	26	0915												X	X									X		X	X	
Pretreatment Samples																														
Influent	Eco	25	1434	X	X	X						X			X	X		X		X		X								
Effluent	Eco	25	1413	X	X	X						X			X	X	X	X		X		X	X	X	X				

X - Analyzed by Ecology
* - Analyzed by Selah

Table 2 - Ecology Analytical Results - Selah, October 1988

Station	Sampler	Date (October)	Time	Temperature (C)	Field Analyses: pH (S.U.)	Conductivity (umhos/cm)	Chlorine Residual (mg/L): Free	Chlorine Residual (mg/L): Total	Fecal Coliform (#/100mL)	Laboratory Analyses: BOD5	Soluble BOD5 (mg/L)	COD (mg/L)	Solids (mg/L): TS	Solids (mg/L): TNVS	Solids (mg/L): TSS	Solids (mg/L): TNVSS	Turbidity (NTU)	Nutrients (mg/L): NH3-N	Nutrients (mg/L): NO2-N	Nutrients (mg/L): NO2+NO3-N	Nutrients (mg/L): O-PO4-P	Nutrients (mg/L): Total P	pH (S.U.)	Conductivity (umhos/cm)	Alkalinity (mg/L as CaCO3)	Hardness	% Solids
Composite																											
STP Samples																											
Influent	Eco	25-26	0730-0730	4.4	7.6	957				200		860	1400	680	670	120	56	7.9	0.04	0.17	R	0.91	7.2	1052	300	154	
Effluent	Eco	25-26	0700-0700	4.2	7.9	868				3 U		35	710	510	4	1 U	1	0.05	0.01 U	0.70	0.28	0.49	7.6	970	260	151	
Influent	Sel	25-26	0730-0730	15.6	7.1	815				220		660	1300	540	590	100	55	7.5		0.01		0.93	6.9	977	290		
Effluent	Sel	25-26	0730-0730	8.5	7.7	892				3 U		24	730	540	3	1 U	1 U	0.08		1.1		0.50	7.7	975	260		
Pretreatment Samples																											
Influent	Eco	25-26	0730-0730	4.6	8.7	1240				1500		1500	3500	840	640	340	78	25	0.07	26		1.1	8.0	1348	200		
Effluent	Eco	25-26	0720-0720	4.5	8.0	1072				270	5 U	1600	2200	970	1300	250	65	0.09	0.01 U	0.12		0.53	7.4	1169	360		
Grab																											
STP Samples																											
Influent	Eco	25	1004	17.6	8.3	1144						570			300	68	90	7.9		2.4		1.4	7.2	1511	350		
		25	1332	18.4	7.1	915						750			1800	250	100	8.1 J		0.67		1.5	6.8	1028	320		
		26	0915	17.7	7.9	787						680			430	80	50	9.7		0.44		1.3	7.2	866	300		
Effluent	Eco	25	1035	15.3	7.4	925	0.6	1.0				31			7	4	1	0.04		1.1		0.34	7.6	1001	260		
		25	1347	16.0	6.9	942	0.1	0.8	3			41			8	2	3	0.05		1.3		0.37	7.7	FQC	260		
		26	0930	15.5	7.7	875	0.6	1.0	1			36			2	1 U	1	0.05		0.36		0.37	7.4	951	260		
Sludge	Eco	26	0915												10800	2800									420		1.3
Pretreatment Samples																											
Influent	Eco	25	1434	23.0	9.2	933						1300			270	130		15		17		0.59					
Effluent	Eco	25	1413	14.3	7.3	1256						1400			1400	230	63	0.04		0.02		0.47	7.3	1141	310		

U Compound was analyzed for but not detected. The associated numerical value is the sample quantitation detection limit.

FQC Failed Quality Control - The analysis is unusable because quality control limits were exceeded when the analysis was conducted.

J Estimated value; not accurate.

R Data unusable. Resampling and reanalysis necessary.

Table 3 Comparison of Ecology Laboratory Results to NPDES Permit Limits - Selah, October 1988

	NPDES Permit Limits*					Inspection Data			
Parameter	Monthly Average	Weekly Average	Design Criteria	85% Loading	Revised Plant Capacity Estimates (Jump et al, 1989)	Ecology Composite	STP Composite	Grab Samples	STP Totalizer
Flow (MGD)	2.1		2.1	1.8	2.0				1.18
Influent BOD5 (mg/L)						200	220		
(lbs/D)			6000	5100	3300	1970	2165		
BOD5 (mg/L)	30	45				<3	<3		
(lbs/D)	525	788				<30	<30		
(% removal)	>85					98.5	98.6		
Influent TSS (mg/L)						670	590		
(lbs/D)			6130	5210	3300	6590	5810		
TSS (mg/L)	30	45				4	3		
(lbs/D)	525	788				39	30		
(% removal)	>85					99.4	99.5		
Fecal coliform (#/100 mL)	200	400						3; 1	
NH_3-N(mg/L)	**	**				0.05	0.08		
pH (S.U.)	6.0≤pH≤9.0							7.4; 6.9; 7.7	

* NPDES Permit #WA-002103-2 expired October 18, 1987
** Shall not exceed 15 mg/L between May 1 and October 30

Table 4 - Sludge Depth Data - Selah, October 1988

Unit*	Tank Depth (ft)	Clear water Depth (ft)	Sludge Depth (ft)
South Clarifier**	11	3.5	7.5
North Clarifier**	16	4.5	11.5
Chlorine Contact Chamber			<1

* Sampling was done with a "sludge judge" tube sampler at 1100 on October 25.

** The operator reported that approximately 25% of the total flow was routed through the south clarifier and 75% through the larger north clarifier.

Table 5 - STP Effluent Microtox Bioassay Results - Selah, October 1988

Exposure time:	5 minute		15 minute		30 minute	
	EC50	Ranking*	EC50	Ranking*	EC50	Ranking*
STP effluent with chlorine residual (0.7 mg/L Cl_2)	27.6%	Moderate	17.6%	High	13.4%	High
STP effluent with chlorine neutralized	38.8%	Moderate	25.5%	Moderate	19.5%	High

EC50 - concentration effecting 50% of the test organisms
* - relative rankings to aid in prioritizing the need for further toxicity investigation (EPA 1980)

Table 6 - Sludge Metals Results - Selah, October 1988

Metal	STP** sample (mg/kg dry wt)	Data from previous inspections* Range (mg/kg dry wt)	Geometric mean (mg/kg dry wt)	Number of samples
Cd	1.5	<0.1-25	7.6	34
Cr	22	15-300	62	34
Cu	109	75-1700	398	34
Pb	15	34-600	207	34
Ni	9.4	<0.1-62	25	29
Zn	192	165-3370	1200	33

* Summary of data collected for digested sludge from activated sludge plants during previous Class II inspections in the state (Hallinan, 1988).

** Percent solids = 1.3

Table 7 - Estimation of Aerobic Digester Loading - Selah, October 1988

Given: Digester volume - 465,750 gal or 62,270 ft^3 (Shepherd, 1985)

Sludge sent to land application - 75,000 gal 5x per week = 53,600 gal/D (per operator)

Sludge wasted to digester = 80,700 gpd (October 1988 plant records)

%VSS to digester = 78% (Based on MLSS & MLVSS data in the October 1988 plant records)

%VSS to disposal = 74% (Inspection data)

TSS in WAS = 9800 mg/L (October 1988 plant records)

	Calculated at Land Application Rate	Calculated at Wasting Rate	WDOE Design Criteria (Ecology 1985)	Process to Significantly Reduce Pathogens (Ecology 1982)
Hydraulic detention time (days)	8.7	5.8	15-25+	
VS loading rate ($lbs/ft^3/D$)	0.055*	0.083*	0.1-0.2	
% VS reduction	19%	19%	40-50%	at least 38%
VS in digested sludge	74%*	74%	60%	

+ @ 20°c

* Calculations made using TSS data. Ecology waste sludge results showed a TSS of 10800 mg/L and total solids of 1.3% (13000 mg/L) suggesting use of TSS data for estimates is valid.

Table 8 - Pretreatment Effluent Data Comparison - Selah, October 1988

	BOD_5		Soluble BOD_5		TSS		FLOW
	mg/L	lbs/D	mg/L	lbs/D	mg/L	lbs/D	MGD
Ecology Class II Data							
Pretreatment Effluent	270	1148	<5	<21	1300	5529	0.51
STP Influent	200	1968			670	6594	1.18
Percent from Pretreatment		58%				84%	43%
Selah October 1988 Average Data							
Pretreatment Effluent	379	1549	19	78	1368	5590	0.49
STP Influent	229	2196			695	6666	1.15
Percent from Pretreatment		71%				84%	43%

Table 9 - Pretreatment Effluent Settling Test Results - Selah, October 1988

	Volume of Sludge*				
Sample	0 minutes	10 minutes	20 minutes	30 minutes	40 minutes
Grab**	1000 mLs	900 mLs	650 mLs		500 mLs
Composite**	1000 mLs	1000 mLs		675 mLs	

* Tests run with 1000 mLs of sample in a one liter graduated cylinder. Tests started at 0950 on October 26.

** Temperature of the pretreatment effluent composite sample was 5.0 degrees C at the beginning of test. The temperature of the grab sample was not measured, but the effluent temperature at 1413 on October 25 was 14.3 degrees C.

Table 10 - Comparison of Laboratory Results Selah, October 1988

Station	Date	Time	Sampler	Laboratory	Total Chlorine Residual (mg/L)	Fecal Coliform (#/100mL)	BOD_5 (mg/L)	TSS (mg/L)	NH_3-N (mg/L)
Composite									
Influent	10/25-26	0730-0730	Ecology	Ecology			200	670	7.9
				Selah			375	700	7.72
		0730-0730	Selah	Ecology			220	590	7.5
				Selah			432	610	8.90
Effluent	10/25-26	0700	Ecology	Ecology			3 U	4	0.05
		0700		Selah			11	14	0.71
		0730-0730	Selah	Ecology			3 U	3	0.08
				Selah			9	10	0.37
Grab									
Effluent	10/26	0800	Selah	Selah	1.5				
		0930	Ecology	Ecology	1.0	1			
			Selah	Selah		1			

APPENDIX

Laboratory Procedure Review Sheet

Discharger: Selah

Date: 10/25/88

Discharger representative: Sharon Hill

Ecology reviewer: Carlos E. Ruiz

Instructions

Questionnaire for use reviewing laboratory procedures. Circled numbers indicate work is needed in that area to bring procedures into compliance with approved techniques. References are sited to help give guidance for making improvements. References sited include:

Ecology = Department of Ecology Laboratory User's Manual, December 8, 1986.

SM = APHA-AWWA-WPCF, Standard Methods for the Examination of Water and Wastewater. 16th ed., 1985.

SSM = WPCF, Simplified Laboratory Procedures for Wastewater Examination, 3rd ed., 1985.

Sample Collection Review

1. Are grab, hand composite, or automatic composite samples collected for influent and effluent BOD and TSS analysis?

2. If automatic compositor, what type of compositor is used? Manu
   The compositor should have pre and post purge cycles unless it is a flow through type. Check if you are unfamiliar with the type being used.

3. Are composite samples collected based on time or (flow)?

4. What is the usual day(s) of sample collection? 7:30a - 7:30

5. What time does sample collection usually begin?

6. How long does sample collection last? 24

7. How often are subsamples that make up the composite collected?

8. What volume is each subsample? 100

9. What is the final volume of sample collected? >1 gal

10. Is the composite cooled during collection? yes

(11) To what temperature? 4 °C ; 1 broken
The sample should be maintained at approximately 4 degrees C (SM p41, #5b: SSM p2).

12. How is the sample cooled?
Mechanical refrigeration or ice are acceptable. Blue ice or similar products are often inadequate.

13. How often is the temperature measured?
The temperature should be checked at least monthly to assure adequate cooling.

14. Are the sampling locations representative? yes

15. Are any return lines located upstream of the influent sampling location? no
This should be avoided whenever possible.

16. How is the sample mixed prior to withdrawal of a subsample for analysis? yes
The sample should be thoroughly mixed.

17. How is the subsample stored prior to analysis?
The sample should be refrigerated (4 degrees C) until about 1 hour before analysis, at which time it is allowed to warm to room temperature.

18. What is the cleaning frequency of the collection jugs? 2 weeks
The jugs should be thoroughly rinsed after each sample is complete and occasionally be washed with a non-phospate detergent.

19. How often are the sampler lines cleaned? wash
Rinsing lines with a chlorine solution every three months or more often where necessary is suggested.

pH Test Review

1. How is the pH measured? pH meter
A meter should be used. Use of paper or a colorimetric test is inadequate and those procedures are not listed in Standard Methods (SM p429).

2. How often is the meter calibrated? every morning
The meter should be calibrated every day it is used.

(3) What buffers are used for calibration? 7 and 4
Two buffers bracketing the pH of the sample being tested should be used.
7-10 may be more appropriate
If the meter can only be calibrated with one buffer, the buffer closest in pH to the sample should be used. A second buffer, which brackets the pH of the sample should be used as a check. If the meter cannot accurately determine the pH of the second buffer, the meter should be repaired.

BOD Test Review

1. What reference is used for the BOD test? Standard Methods 14th
   Standard Methods or the Ecology handout should be used.
   get new one

2. How often are BODs run? every day
   The minimum frequency is specified in the permit.

3. How long after sample collection is the test begun? 4-6 hr
   The test should begin within 24 hours of composite sample completion (Ecology Lab Users Manual p42). Starting the test as soon after samples are complete is desirable.

4. Is distilled or deionized water used for preparing dilution water? distilled

5. Is the distilled water made with a copper free still? yes
   Copper stills can leave a copper residual in the water which can be toxic to the test (SSM p36).

6. Are any nitrification inhibitors used in the test? NO What?
   2-chloro-6(trichloro methyl) pyridine or Hach Nitrification Inhibitor 2533 may be used only if carbonaceous BODs are being determined (SM p 527, #4g: SSM p 37).

7. Are the 4 nutrient buffers of powder pillows used to make dilution water? yes
   If the nutrients are used, how much buffer per liter of dilution water are added?
   1 mL per liter should be added (SM p527, #5a: SSM p37).

8. How often is the dilution water prepared? daily
   Dilution water should be made for each set of BODs run

9. Is the dilution water aged prior to use? yes
   Dilution water with nitrification inhibitor can be aged for a week before use (SM p528, #5b).
   Dilution water without inhibitor should not be aged.

10. Have any of the samples been frozen? NO
    If yes, are they seeded?
    Samples that have been frozen should be seeded (SSM p38).

11. Is the pH of all samples between 6.5 and 7.5? 4-8
    If no, is the sample pH adjusted?
    The sample pH should be adjusted to between 6.5 and 7.5 with 1N NaOH or 1N H_2SO_4 if 6.5 > pH >7.5 if caustic alkalinity or acidity is present (SM p529, #5e1: SSM p37).
    High pH from lagoons is usually not caustic. Place the sample in the dark to warm up, then check the pH to see if adjustment is necessary.

    If the sample pH is adjusted, is the sample seeded? seed no pH adj.
    The sample should be seeded to assure adequate microbial activity if the pH is adjusted (SM p528, #5d)

12. Have any of the samples been chlorinated or ozonated? yes
If chlorinated are they checked for chlorine residual and dechlorinated as necessary?
How are they dechlorinated? sodium thiosulfate
Samples should be dechlorinated with sodium sulfite (SM p529, #5e2: SSM p38), but dechlorination with sodium thiosulfate is common practice. Sodium thiosufate dechlorination is probably acceptable if the chlorine residual is < 1-2 mg/L.
If chlorinated or ozonated, is the sample seeded? yes
The sample should be seeded if it was disinfected (SM p528, #5d&5e2: SSM p38).

13. Do any samples have a toxic effect on the BOD test? NO
Specific modifications are probably necessary (SM p528, #5d: SSM p37).

14. How are DO concentrations measured? YSI meter ; DO probe
If with a meter, how is the meter calibrated? air ; saturated
Air calibration is adequate. Use of a barometer to determine saturation is desirable, although not manditory. Checks using the Winkler method of samples found to have a low DO are desirable to assure that the meter is accurate over the range of measurements being made.

How frequently is the meter calibrated? daily
The meter should be calibrated before use.

15. Is a dilution water blank run? yes
A dilution water blank should always be run for quality assurance (SM p527, #5b: SSM p40, #3).

What is the usual initial DO of the blank? 7.5 - 8.0
The DO should be near saturation; 7.8 mg/L @ 4000 ft, 9.0 mg/L @ sea level (SM p528, #5b). The distilled or deionized water used to make the dilution water may be aged in the dark at ~20 degrees C for a week with a cotton plug in the opening prior to use if low DO or excess blank depletion is a problem.

What is the usual 5 day blank depletion? 0.6 - less than -
The depletion should be 0.2 mg/L or less. If the depletion is greater, the cause should be found (SM p527-8, #5b: SSM p41, #6).

16. How many dilutions are made for each sample? 3
At least two dilutions are recommended. The dilutions should be far enough apart to provide a good extended range (SM p530, #5f: SSM p41).

17. Are dilutions made by the liter method or in the bottle? bottle
Either method is acceptable (SM p530, #5f).

18. How many bottles are made at each dilution? 4 on effluents; 2 clean
How many bottles are incubated at each dilution?
When determining the DO using a meter only one bottle is necessary. The DO is measured, then the bottle is sealed and incubated (SM p530, #5f2).
When determining the DO using the Winkler method two bottles are necessary. The initial DO is found of one bottle and the other bottle is sealed and incubated (Ibid.).

19. Is the initial DO of each dilution measured? yes
What is the typical initial DO? 7.5 - 8.0
The initial DO of each dilution should be measured. It should approximate saturation (see #14).

20. What is considered the minimum acceptable DO depletion after 5 days? depends on range (history)
What is the minimum DO that should be remaining after 5 days?
The depletion should be at least 2.0 mg/L and at least 1.0 mg/L should be left after 5 days (SM p531, #6: SSM p41).

21. Are any samples seeded? yes
Which? effluent
What is the seed source?
Primary effluent or settled raw wastewater is the preferred seed. Secondary treated sources can be used for inhibited tests (SM p528, #5d: SSM p41).

How much seed is added to each sample? 1 ml
Adequate seed should be used to cause a BOD uptake of 0.6 to 1.0 mg/L due to seed in the sample (SM p529, #5d).

How is the BOD of the seed determined? BOD of 2nd dilution
Dilutions should be set up to allow the BOD of the seed to be determined just as the BOD of a sample is determined. This is called the seed control (SM p529, #5d: SSM p41). 3 dilutions

22. What is the incubator temperature? 20°C
The incubator should be kept at 20 +/- 1 degree C (SM p531, #5i: SSM p40, #3).

How is incubator temperature monitored? check every day w/water bath thermometer
A thermometer in a water bath should be kept in the incubator on the same shelf as the BODs are incubated.

How frequently is the temperature checked? daily
The temperature should be checked daily during the test. A temperature log on the incubator door is recommended.

How often must the incubator temperature be adjusted? almost never
Adjustment should be infrequent. If frequent adjustments (every 2 weeks or more often) are required the incubator should be repaired.

Is the incubator dark during the test period? yes
Assure the switch that turns off the interior light is functioning.

23. Are water seals maintained on the bottles during incubation? yes
Water seals should be maintained to prevent leakage of air during the incubation period (SM p531, #5i: SSM p40, #4).

24. Is the method of calculation correct? OK
Check to assure that no correction is made for any DO depletion in the blank and that the seed correction is made using seed control data.

Standard Method calculations are (SM p531, #6):

for unseeded samples;

$$BOD\ (mg/L) = \frac{D1 - D2}{P}$$

for seeded samples;

$$BOD\ (mg/L) = \frac{(D1 - D2) - (B1 - B2)f}{P}$$

Where: D1 = DO of the diluted sample before incubation (mg/L)
D2 = DO of diluted sample after incubation period (mg/L)
P = decimal volumetric fraction of sample used
B1 = DO of seed control before incubation (mg/L)
B2 = DO of seed control after incubation (mg/L)

$$f = \frac{\text{amount of seed in bottle D1 (mL)}}{\text{amount of seed in bottle B1 (mL)}}$$

2.0

2.0

$(8.2 - 7.4)$ $(7.8 - 7.4)\ \frac{1}{300}$

.250

1 dilution .05

Total Suspended Solids Test Review

Preparation

1. What reference is used for the TSS test? Std Methods 14th

(2.) What type of filter paper is used?
Std. Mthds. approved papers are: Whatman 934AH (Reeve Angel), Gelman A/E, and Millipore AP-40 (SM p95,footnote: SSM p23) GF/C whatman
get approved paper

3. What is the drying oven temperature? 103-105
The temperature should be 103-105 degrees C (SM p96, #3a: SSM p23).

4. Are any volatile suspended solids tests run? yes
If yes--What is the muffle furnance temperature? 600°
The temperature should be 550+/- 50 degrees C (SM p98, #3 SSM p23).

5. What type of filtering apparatus is used? Membrane
Gooch crucibles or a membrane filter apparatus should be used (SM p95, #2b: SSM p23).

(6.) How are the filters pre-washed prior to use? no; will do
The filters should be rinsed 3 times with distilled water (SM p23, #2: SSM p23. #2).

Are the rough or smooth sides of the filters up? rough
The rough side should be up (SM p96, #3a: SSM p23, #1)

How long are the filters dried? 1hr minimum
The filters should be dried for at least one hour in the oven. An additional 20 minutes of drying in the furnance is required if volatile solids are to be tested (Ibid).

How are the filters stored prior to use? dessicator
The filters should be stored in a dessicator (Ibid).

7. How is the effectiveness of the dessicant checked? blue; good
All or a portion of the dessicant should have an indicator to assure effectiveness.

Test Procedure

8. In what is the test volume of sample measured? 25 ml pipette
The sample should be measured with a wide tipped pipette or a graduated cylinder.

9. Is the filter seated with distilled water? yes
The filter should be seated with distilled water prior to the test to avoid leakage along the filter sides (SM p97, #3c).

10. Is the entire measured volume always filtered? yes
The entire volume should always be filtered to allow the measuring vessel to be properly rinsed (SM p97, #3c: SSM p24, #4).

11. What are the average and minimum volumes filtered?

	Volume	
	Minimum	Average
Influent	10	10
Effluent	25	25

12. How long does it take to filter the samples?

	Time
Influent	0
Effluent	0

13. How long is filtering attempted before deciding that a filter is clogged? 1-2 minutes) good estimate
Prolonged filtering can cause high results due to dissolved solids being caught in the filter (SM p96, #1b). We usually advise a five minute filtering maximum.

14. What do you do when a filter becomes clogged? discard
The filter should be discarded and a smaller volume of sample should be used with a new filter.

15. How are the filter funnel and measuring device rinsed onto the filter following sample addition? 5-10 mls
Rinse 3x's with approximately 10 mLs of distilled water each time (??).

16. How long is the sample dried? 1
The sample should be dried at least one hour for the TSS test and 20 minutes for the volatile test (SM p97, #3c; p98, #3: SSM p24, #4) Excessive drying times (such as overnight) should be avoided.

17. Is the filter thoroughly cooled in a dessicator prior to weighing? yes
The filter must be cooled to avoid drafts due to thermal differences when weighing (SM p97, #3c: SSM p97 #3c)

18. How frequently is the drying cycle repeated to assure constant filter weight has ben reached (weight loss <0.5 mg or 4%, whichever is less: SM p97, #3c)? 10 cycles now 1 every two weeks w/good results
We recommend that this be done at least once every 2 months.

19. Do calculations appear reasonable?
Standard Methods calculation (SM p97, #3c).

$$mg/L\ TSS = \frac{(A - B) \times 1000}{\text{sample volume (mL)}}$$

.1281
.1271

25 ml

where: A= weight of filter + dried residue (mg,
B= weight of filter (mg)

Fecal Coliform Test Review

1. Is the Membrane Filtration (MF) or Most Probable Number (MPN) technique used? Membrane
   This review is for the MF technique.

2. Are sterile techniques used? yes

3. How is equipment sterilizated? pressure cooker; autoclave; oven
   Items should be either purchased sterilized or be sterilized. Steam sterilization, 121 degrees C for 15 to 30 minutes (15 psi); dry heat, 1-2 hours at 170 degrees C; or ultraviolet light for 2-3 minutes can be used. See Standard Methods for instructions for specific items (SSM p67-68).

4. How is sterilization preserved prior to item use?
   Wrapping the items in kraft paper or foil before they are sterilized protects them from contamination (Ibid.).

5. How are the following items sterilized?

	Purchased Sterile	Sterilized at Plant
Collection bottles		✓
Phosphate buffer		✓
Media	✓	
Media pads	✓	
Petri dishes	✓	✓
Filter apparatus		
Filters	✓	
Pipettes	✓	
Measuring cylinder		✓
Used petri dishes	—	—

6. How are samples dechlorinated at the time of collection? ok
   Sodium thiosulfate (1 mL of 1% solution per 120 mLs (4 ounces) of sample to be collected) should be added to the collection bottle prior to sterilization (SM p856, #2: SSM p68, sampling).

7. Is phosphate buffer made specifically for this test? yes
   Use phosphate buffer made specifically for this test. The phosphate buffer for the BOD test should not be used for the coliform test (SM p855, #12: SSM p66).

8. What kind of media is used? M-FC
   M-FC media should be used (SM p896, SSM p66)

9. Is the media mixed or purchased in ampoules? yes
   Ampoules are less expensive and more convient for under 50 tests per day (SSM p65, bottom)

10. How is the media stored? ~~Boil~~
    The media should be refrigerated (SM p897, #1a: SSM p66, #5).

11. How long is the media stored?
Mixed media should be stored no longer than 96 hours (SM p897, #1a: SSM p66, #5). ~~Ampoules will usually keep from 3-6 months~~ -- read ampoule directions for specific instructions.

12. Is the work bench disinfected before and after testing? yes/foil
This is a necessary sanitazation procedure (SM p831, #1f).

13. Are forceps dipped in alcohol and flamed prior to use? yes
Dipping in alcohol and flaming are necessary to sterilize the forceps (SM p889, #1: SSM p73, #4).

14. Is sample bottle thoroughly shaken before the test volume is removed? The sample should be mixed thoroughly (SSM p73, #5). 25

15. Are special procedures followed when less than 20 mLs of sample is to be filtered? 20ml Phosphate 5-10-15
10-30 mLs of sterile phosphate buffer should be put on the filter. The sample should be put into the buffer water and swirled, then the vacuum should be turned on. More even organism distribution is attained using this technique (SM p890, #5a: SSM P73, #5).

16. Are special procedures followed wnen less than 1 mL of sample is to be filtered?
Sample dilution is necessary prior to filtration when <1 mL is to be tested (SM p864, #2c: SSM p69).

17. Is the filter apparatus rinsed with phosphate buffer after sample filtration?
Three 20-30 mL rinses of the filter apparatus are recommended (SM p891, #5b: SSM p75, #7).

18. How soon after sample filtration is incubation begun? right away
Incubation should begin within 20-30 minutes (SM p897, #2d: SSM p77 #10 note).

19. What is the incubation temperature? 44.5
44.5 +/- 0.2 degrees C (SM p897, #2d: SSM p75, #9).

20. How long are the filters incubated? 24
24 +/- 2 hours (Ibid.).

21. How soon after incubation is complete are the plate counts made? [illegible]
The counts should be made within 20 minutes after incubation is complete to avoid colony color fading (SSM p77, FC).

22. What color colonies are counted? blue
The fecal coliform colonies vary from light to dark blue (SM p897, #2e: SSM p78).

23. What magnification is used for counting? magnifying
10-15 power magnification is recommended (SM p898, #2e: SSM p78).

24. How many colonies blue colonies are usually counted on a plate? 0
Valid plate counts are between 20 and 60 colonies (SM p897, #2a: SSM p78).

25. How many total colonies are usually on a plate?
The plate should have <200 total colonies to avoid inhabition due to crowding (SM p893, #6a: SSM p63, top).

26. When calculating results, how are plates with <20 or >60 colonies considered when plates exist with between 20 and 60 colonies?
In this case the plates with <20 or >60 colonies should not be used for calculations (SM p898, #3: SSM p78, C&R).

27. When calculating results how are results expressed if all plates have < 20 or > 60 colonies?
Results should be identified as estimated.
The exception is when water quality is good and <20 colonies grow. In this case the lower limit can be ignored (SM p893, #6a: SSM p78, C&R).

28. How are results calculated?
Standard Methods procedure is (SM p893, #6a: SSM p79):

$$\text{Fecal coliforms/100 mL} = \frac{\text{\# of fecal coliform colonies counted}}{\text{sample size (mL)}} \times 100$$